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Data Stewardship Maturity Report for NOAA Climate Data Record (CDR) of Passive Microwave Sea Ice Concentration, Version 2

Table 1 Legend				
Level 1	Level 2	Level 3	Level 4	Level 5
Ad Hoc	Minimal	Intermediate	Advanced	Optimal
Little or no management	Limited Management	Defined Management, partially implemented	Well-defined Management, fully implemented	Full Management, audited, measured, controlled

Table 1. Scores for the Nine DSMM Key Components at a Glance		
Preservability - 4.5	Accessibility - 2	Usability - 3.5
Production Sustainability - 4	Data Quality Assurance - 3.5	Data Quality Control/Monitoring - 2
Data Quality Assessment - 3	Transparency/Traceability - 3	Data Integrity - 4

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Cover Image: Data Stewardship Rating Diagram for NOAA Climate Data Record (CDR) of Passive Microwave Sea Ice Concentration, Version 2

Shades of green are used to represent level 1 through level 5 ratings; denoting Ad Hoc, Minimal, Intermediate, Advanced, and Optimal stages for each of the nine key components, respectively. The dark green level indicates all the practices are completely satisfied. The lighter green levels indicate only some of the practices are satisfied. The lightest green level indicates none of the practices are satisfied.

The stewardship maturity of NCEI data product, NOAA Climate Data Record (CDR) of Passive Microwave Sea Ice Concentration, Version 2, is assessed based on a reference stewardship maturity framework. The current maturity ratings of NOAA Climate Data Record (CDR) of Passive Microwave Sea Ice Concentration, Version 2 are at Level 1 or higher for all nine key components with zero Level 1, two Level 2, four Level 3, three Level 4, and zero Level 5 key components.

NOAA Technical Memorandum Series
National Environmental Satellite, Data, and Information Service

The National Environmental Satellite, Data, and Information Service (NESDIS) manages the Nation's civil Earth-observing satellite systems, as well as global national data bases for meteorology, oceanography, geophysics, and solar-terrestrial sciences. From these sources, it develops and disseminates environmental data and information products critical to the protection of life and property, national defense, and the national economy, energy development and distribution, global food supplies, and the development of natural resources.

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Preface

In response to the President's Open Government Initiative and related policies, NOAA has committed to providing improved public access to all of its environmental information, to enable research and commercial innovation through ease of data discovery and use [*Casey*, 2016].

OneStop supports NOAA's efforts by leveraging existing access technologies and infusing specific innovations to provide improved discover, access, and visualization services for NOAA's data. Also, OneStop is viewed by a NESDIS as a pathfinder effort with an initial focus on selected high-priority datasets from NESDIS and other program data meeting OneStop standards, but eventually scalable across NOAA's data. Lastly, OneStop is implementing the USGEO Common Framework for Earth Observation Data and leveraging/supporting the NOAA Big Data Project (BDP) and Big Earth Data Initiative (BEDI) [*Casey*, 2016].

As with any process of improvement planning, agencies need to find out where they are in terms of their compliance to the federal regulations and what they need to do if any areas of non-compliance are identified. To this end, a unified framework would be beneficial for assessing the current stage of stewardship practices applied to individual datasets and for providing a road map that will guide future investments towards enhanced stewardship of environmental datasets. The value and quality of a dataset depends in part on the stewardship practices applied after its development and production. Therefore, a unified framework providing a holistic view of the quality of stewardship practices applied to individual datasets is beneficial to data stewards and users [*Casey*, 2016].

The data stewardship maturity matrix (DSMM), jointly developed by domain (data management, technology, and science) subject matter experts from NOAA's National Centers for Environmental Information (NCEI) and Cooperative Institute for Climate and Satellites – North Carolina (CICS-NC), provides such a consistent framework [*Peng et al.,* 2016]. The DSMM, leveraging institutional knowledge and community practices and standards, defines a graduated maturity scale for each of nine key components of scientific data stewardship to enable a consistent assessment of the measurable stewardship practices applied to a given data set or product.

The NOAA data stewardship maturity technical series captures stewardship maturity assessment results for individual datasets, provides consistent representation and citable documents of those assessments, ensures transparency, and allows better data quality information integration and content-based search and discovery of NOAA data.

NOAA Technical Report NESDIS DSMR-00006

Data Stewardship Maturity Report for NOAA Climate Data Record (CDR) of Passive Microwave Sea Ice Concentration, Version 2

1. Introduction

1.1 Purpose

The purpose of this document is to describe the results of stewardship maturity assessment for NOAA Climate Data Record for Mean Layer Temperature (Upper Troposphere & Lower Stratosphere from UCAR, Version 2, utilizing the Scientific Data Stewardship Maturity Matrix or DSMM [Peng, et al, 2016]. DSMM defines levels of stewardship maturity stages for Preservability, Accessibility, Usability, Production Sustainability, Data Quality Assurance, Data Quality Control/Monitoring, Data Quality Assessment, Transparency/Traceability, and Data Integrity key components. Each of these components is ranked from 'Ad hoc' to 'Optimal' (see Appendix I). This report is based on evaluation performed by NOAA OneStop metadata specialists working with Subject Matter Experts and utilizing the DSMM template [Peng, 2016].

1.2 Scope

Assessing stewardship maturity - the current state of how datasets are documented, preserved, stewarded, and made accessible publicly, is a critical step towards meeting U.S. federal regulations, organizational requirements, and user needs [Peng et al., 2016]. The goal of this document is to provide consistent and transparent stewardship maturity information to data users and decision-makers.

1.3 Dataset Abstract

The Passive Microwave Sea Ice Concentration Climate Data Record (CDR) dataset is generated using daily gridded brightness temperatures from the Defense Meteorological Satellite Program (DMSP) series of Special Sensor Microwave Imager (SSM/I) passive microwave radiometers onboard F-8, F-11 and F-13, and from the Special Sensor Microwave Imager/Sounder (SSMIS) data onboard F-17. The sea ice concentrations are an estimate of the fraction of ocean area covered by sea ice for both the north and south Polar Regions. The daily product is produced by combining concentration estimates created using two algorithms developed at the NASA Goddard Space Flight Center (GSFC) that are processed and combined at NSIDC using brightness temperature data from Remote Sensing Systems, Inc. (RSS). The data are gridded on the NSIDC polar stereographic grid with 25 x 25 km grid cells and are available in netCDF file format. The monthly averaged data have the same spatial resolution and format. Improvements since Version 1 include: 1) an extended data record from 2007 to present; 2) using SSMIS data from F-17; 3) a new snow melt variable; 4) netCDF metadata improvements; and 5) updated documentation and source code.

1.4 Document Maintenance

This document is generated and maintained by NOAA's National Centers for Environmental Information. More on policy is available at https://www.ncei.noaa.gov/.

2. Results

The data stewardship maturity assessment information is summarized in Table 1. Each component is displayed along with its corresponding score in a color-coded table.

Table 2. Dataset and Data Stewardship Maturity Assessment Metadata	
Dataset Title	NOAA Climate Data Record (CDR) of Passive Microwave Sea Ice Concentration, Version 2
Dataset Information URL	https://doi.org/10.7265/N55M63M1
Data Provider POC (name; email; affliation)	NOAA National Centers for Environmental Information, ncei.orders@noaa.gov
Dataset POC (name; email; affliation)	NOAA Climate Data Record Program Office, sea_ice_concentration_contacts@noaa.gov
SMM Version (Document ID and Version Number)	NCDC-CICS-SMM_0001_Rev.1 12/09/2014
SMM POC (Name; E-mail; Affiliation)	Ge Peng, ge.peng@uah.edu, University of Alabama-Huntsville
SMM Template Version (Document ID and Version Numbers)	NCDC-CICS-SMM_0001_Rev.1 v4.0 06/23/2015
SMM Template POC	Ge Peng, ge.peng@uah.edu, University of Alabama-Huntsville
SMM Assessment Version (v<nn>r<mm>, e.g., v01r00)	V04r01
SMM Assessment Date (MM/DD/YYYY)	04/10/2019
SMM Assessment POC (Name; E-mail; Affiliation)	Paul Lemieux III, paul.lemieux@noaa.gov, Riverside Technology, Inc.
Stewardship Maturity Ratings (each key component) (kc1/kc2/kc3/kc4/kc5/kc6/kc7/kc8/kc9)	4.5 / 2 / 3.5 / 4 / 3.5 / 2 / 3 / 3 / 4
SMM Original Assessment Date (MM/DD/YYYY)	10/16/2014
SMM Original Assessment POC (Name; E-mail; Affiliation)	Donna Scott, dscott@nsidc.org, NSIDC; Ge Peng, ge.peng@uah.edu, University of Alabama-Huntsville
SMM Last Modified Date (MM/DD/YYYY)	09/21/2021
SMM Last Modification POC (Name; E-mail; Affiliation)	Katy Luquire, catherine.luquire@noaa.gov , CASE Consultants International
SMM Modified Date (MM/DD/YYYY)	04/10/2019
SMM Modification POC (Name; E-mail; Affiliation)	Paul Lemieux III, paul.lemieux@noaa.gov, Riverside Technology, Inc.

Table 3. Stewardship Maturity Levels and Detailed Justifications for Each of Nine DSMM Key Components for the Dataset	
DSMM Key Component	Stewardship Maturity Rating, Justification, and Comments
Preservability	Level 4.5 ▪ Archived at NOAA NCEI ▪ Following NOAA Climate Data Record (CDR) Research-2-Operation (R2O) transition process with the Initial Operation Capability (IOC) ▪ Following ISO OAIS RM ▪ Conforming to ISO 19115-2 metadata standards ▪ Conforming to NetCDF CF metadata conventions ▪ Conforming to CDR Program (CDRP) guidelines on coding and NCEI Archive Branch (AB) guidance on file and variable naming conventions per Submission Agreement (SA) ▪ Plans to transition ISO metadata to newer 19115-1 standard Comments: No known audits of the archiving processes
Accessibility	Level 2 ▪ Collection metadata searchable via OneStop: https://data.noaa.gov/onestop/#/ ▪ Direct download available via HTTPS: https://www.ncei.noaa.gov/data/sea-ice-concentration/access/ ▪ Direct download available via THREDDS catalog: https://www.ncei.noaa.gov/thredds/catalog/cdr/sea-ice-concentration/catalog.html ▪ Reports available internally for the FTP/HTTP servers ▪ New technology for OneStop search and discovery planned (i.e. ElasticSearch, Hyrax Servers, etc.) This is part of the CDR data group that will be OneStop ready. Comments: Dissemination reports are available internally, but are not available online Public NSIDC FTP access for v2 product no longer available. Users must email NSIDC user services for access.
Usability	Level 3.5 ▪ NetCDF-4 data format (CF compliant) ▪ Data Flow Diagram [Fetterer and NOAA CDR Program, 2015] is available online here: ▪ C-ATBD [Meier and Windnagel, 2015] is available online here: ▪ Error assessment and estimates available in the C-ATBD [Meier and Windnagel, 2015] available online here: ▪ Some data characterization on the global scale available in literature [DeRepentigny, Tremblay, Newton, _et al_, 2016] which is available online here: https://doi.org/10.3402/polar.v33.21004 Comments: No subsetting or aggregating options in place No known external ranking

Table 3. Stewardship Maturity Levels and Detailed Justifications for Each of Nine DSMM Key Components for the Dataset.	
DSMM Key Component	Stewardship Maturity Rating, Justification, and Comments
Production Sustainability	Level 4 ▪ Under NOAA CDR Operation & Maintenance (O&M) ▪ Updated annually ▪ Funding is allocated yearly to the CDR program ▪ Product improvement (versioning) process in place Comments: No comments
Data Quality Assurance	Level 3.5 ▪ Agile development procedure in place with a defined/fixed set of analysis metrics ▪ Master reference data are included in the source code package available online: ▪ Weather filters ▪ SST Mask ▪ Cell data quality flag in each data file ▪ No data quality assurance metadata implemented Comments: No known external review
Data Quality Control/ Monitoring	Level 2 ▪ DQC is done after each data processing ▪ Sampling is regular in space but no automatic ▪ Procedure not documented or available online Comments: No data quality information in the metadata record
Data Quality Assessment	Level 3 ▪ Sea ice concentration retrieval algorithms (NASA Team and Bootstrap) have been validated extensively with many published peer-review papers ▪ So are research products (Goddard products) for this dataset ▪ Verification of the dataset is done and described in literature [DeRepentigny, Tremblay, Newton, _et al_, 2016] available online here: https://doi.org/10.3402/polar.v33.21004 Comments: No data quality assessment information I the metadata record

Table 3. Stewardship Maturity Levels and Detailed Justifications for Each of Nine DSMM Key Components for the Dataset.	
DSMM Key Component	Stewardship Maturity Rating, Justification, and Comments
Transparency / Traceability	Level 3 ▪ Product information available in literature [Peng, Meier, Scott, _et al_, 2013] which is available online here: https://doi.org/10.5194/essd-5-311-2013 ▪ C-ATBD [Meier and Windnagel, 2015] available online here: ▪ DOI assigned: https://doi.org/10.7265/N55M63M1 ▪ NCEI OID assigned: DSI-3628-02 ▪ Dataset Configuration Management is EIA-649-B standard compliant and diagramed in this presentation document [Hutchins, 2015] which is available online here: http://www1.ncdc.noaa.gov/pub/data/sds/cdr/conferences/2015%20PI%20Annual%20Meeting%20-%20Presentations/Day_1/(A-2)%20Operations%20and%20Maintenanc e%20(O_M)%20of%20NOAA%20IOC%20CDRs%20-%20(Hutchins).pdf Comments: No comments
Data Integrity	Level 4 ▪ Checksum is created by NSIDC for each month tar file staged for NCEI ▪ NCEI ingest validates each file base on checksum before archive ▪ NSIDC generates the checksum for each data file and online for user to verify data integrity Comments: No comments

3. Acknowledgment

This work is supported by the NOAA OneStop Project.

We thank the dataset POCs for their valuable input, as well as the collaborative efforts of the OneStop teams, especially the Metadata team. We would also like to show appreciation to Ge Peng for her contributions.

The draft of this data stewardship maturity report is systematically generated by a tool created by Kieran Hodnett and populated with the stewardship maturity assessment done by the author(s) of this report. The tool was developed based on a Word template created collaboratively by Robert Partee II, Raisa Ionin, Paul Lemieux III, Ge Peng, Don Collins, and Sonny Zinn with helpful input from the NOAA Central Library and the NCEI Communication Team.

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Appendix I: The Scientific Data Stewardship Maturity Matrix (DSMM)

Table A1: This matrix (Version: NCDC-CICS-SMM-0001-Rev.1. 12/09/2014) describes the criterion used to evaluate data stewardship maturity for each of the nine DSMM key components [*Peng et al.*, 2015]

DSMM Component	**Level 1** ***Ad hoc*** Little or no management	**Level 2** ***Minimal*** Limited management	**Level 3** ***Intermediate*** Defined management, partially implemented	**Level 4** ***Advanced*** Well-defined management, fully implemented	**Level 5** ***Optimal*** Full management, audited, measured, controlled
Preservability *(The state of being preservable)*	Any storage location Data only	Non-designated repository Redundancy Limited archiving metadata	Designated archive Redundancy Community-standard archiving metadata Conforming to limited archiving standards	Level 3 + Conforming to community archiving standards	Level 4 + Archiving process performance controlled, measured, and audited Future archiving standard changes planned
Accessibility *(The state of being searchable and accessible publicly)*	Not publically available person-to-person	Publically available direct file download (e.g., via anonymous FTP server) Collection or dataset level searchable online	Level 2 + Non-standard data service Limited data server performance Granule/file level searchable Limited search metrics	Level 3 + Community-standard data service Enhanced data server performance Conforming to community search metrics Dissemination report metrics defined and implemented internally	Level 4 + Dissemination reports available online Future technology and standard changes planned

Usability *(The state of being easy to use)*	Extensive product-specific knowledge required No documentation online	Non-standard data format Limited documentation (e.g., user's guide online)	Community standard-based interoperable format & metadata Documentation (e.g. source code, product algorithm document, processing or/and data flow diagram) online	Level 3 + Basic capability (e.g., subsetting, aggregating) & data characterization overall/global, e.g., climatology, error estimates) available online	Level 4 + Enhanced online capability (e.g., visualization, multiple data formats) Community metrics of data characterization (regional/cell) online External ranking
Production Sustainability *(The state of data production being sustainable and extendable)*	Ad Hoc or Not applicable To obligation or deliverable requirement	Short-term Individual PI's commitment (grant obligations)	Medium-term Institutional commitment (contractual deliverables with specs and schedule defined)	Long-term Institutional commitment Product improvement process in place	Level 4 + National or international commitment Changes for echnology planned
Data Quality Assurance *(The state of data quality being assured)*	Data quality assurance (DQA) procedure unknown or none	Ad Hoc and random QA procedure not defined and documented	DQA procedure defined and documented and partially implemented	DQA procedure well documented, fully implemented and available online with master reference data Limited data quality assurance metadata	Level 4 + DQA procedure monitored and reported Conforming to community quality metadata & standards External review

Data Quality Control/ Monitoring *The state of data quality being controlled and monitored*	None or Sampling unknown or spotty Analysis unknown or random in time	Sampling and analysis are regular in time and space Limited product-specific metrics defined & implemented	Level 2 + Sampling and analysis are frequent and systematic but not automatic Community metrics defined and partially implemented Procedure documented and available online	Level 3 + Anomaly detection procedure well-documented and fully implemented using community metrics, automatic, tracked and reported Limited quality monitoring metadata	Level 4 + Cross-validation of temporal & spatial characteristics Physical consistency check Conforming to community quality metadata & standards
Data Quality Assessment *(The state of data quality being assessed)*	Algorithm/ method/model Theoretical basis assessed (methods and results online)	Level 1 + Research product assessed (methods and results online)	Level 2 + Operational product assessed (methods and results online)	Level 3 + Quality metadata assessed Limited quality assessment metadata	Level 4 + Assessment performed on a recurring basis Conforming to community quality metadata & standards External ranking
Transparency/ Traceability *(The state of being transparent, trackable, and traceable)*	Limited product information available Person-to-person	Product information available in literature	Algorithm Theoretical Basis Document (ATBD) & source code online Dataset configuration managed (CM) Unique Object Identifier (OID) assigned (dataset, documentation, source code) Data citation tracked (e.g., utilizing Digital Object Identifier	Level 3 + Operational Algorithm Description (OAD) online, OID assigned, and under CM	Level 4 + System information online Complete data provenance online

Data Integrity *(The state of data integrity being verifiable)*	Unknown or no data ingest integrity check	Data ingest integrity verifiable (e.g, checksum technology)	(DOI) system) Level 2 + Data archive integrity verifiable	Level 3 + Data access integrity verifiable Conforming to community data integrity technology standard	Level 4 + Data authenticity verifiable (e.g., data signature technology) Performance of data integrity check monitored and reported